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PROJECTED DISTRIBUTION OF FAMILIES AND UNRELATED INDIVIDUALS BY INCOME CLASS 1975 - 1990

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WORKING PAPER :

PROJECTED DISTRIBUTION OF FAMILIES AND UNRELATED INDIVIDUALS BY INCOME CLASS 1975 - 1990

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INTRODUCTION

A key variable in analyzing all forms of consumer expenditures, especially expenditures for housing, is a projected distribution of families by income class. (Also, the EMPIRIC model (1) of the Eastern Massachusetts Regional Planning Project requires as one of its in-puts an absolute distribution of families within four income classes for the years 1975 and 1990.) Within the housing market, (2) tenure, type, value of housing, and location are

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(1) The EMPIRIC model is a computer program being used by the Eastern Massachusetts Regional Planning Project in the development of a comprehensive transportation and land-use plan. A detailed discussion of the model will be presented in a subsequent WORKING PAPER.

(2) A detailed discussion of this general subject area will be presented in a subsequent WORKING PAPER.

all affected by relative distributions of spending power throughout the region. In addition to the housing market, changes in the distribution of income will have a significant impact on other forms of discretionary spending including education, recreation, transportation, and health. As a result, public policy toward education, urban renewal, land use planning and transportation must take account of projected changes in income distribution.

Demonstrating the significance of changes in purchasing power and the distribution of families in various income classes is relatively easy. Estimating the future level of income in the region, and its distribution is more difficult.

This working paper will present the estimated income distributions for families, and unrelated individuals in the Planning Area, the computed median incomes, and a discussion of the findings and their implications. The planning area under discussion is the Eastern Region of Massachusetts which is composed of 152 communities.

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FINDINGS

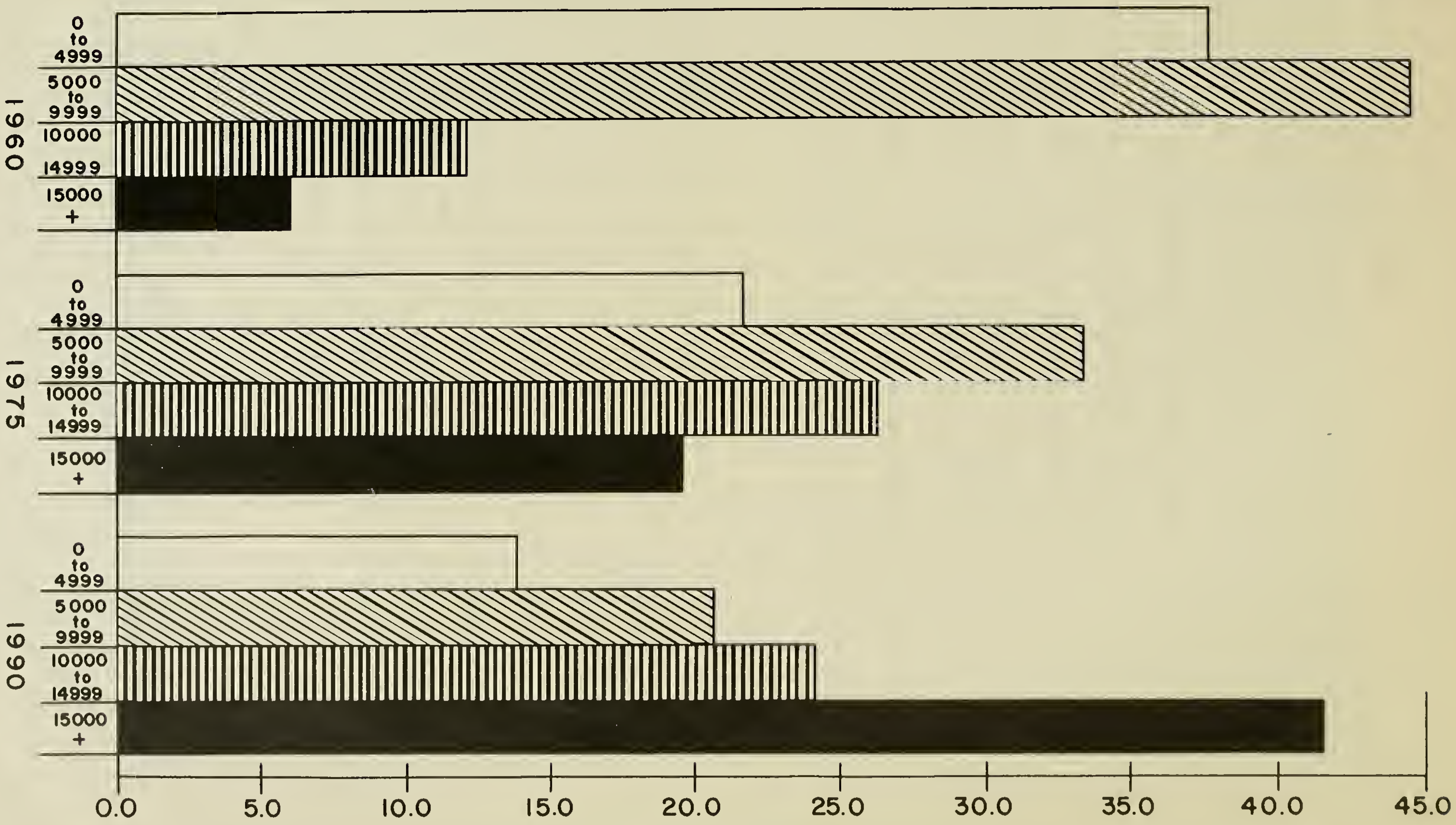
The estimated distributions of the region's households among various income classes is shown in Table 1. The definition of "Families" and "Primary Unrelated Individuals" is identical to that utilized in the U. S. Census of Population, 1960. Thus, a family consists of two or more persons living in the same household who are related to each other by blood, marriage, or adoption; all persons living in one household who are related to each other are regarded as one family. A primary unrelated individual is a head of a household who is living entirely alone or with one or more persons all of whom are not related to the head.

Total real personal income in the region is expected to increase by 65.3 percent between 1960 and 1975, and by another 63.8 percent by 1990, reaching an absolute level of $13.5 billion and $22.1 billion in the two projection years. Over the same period, per capita real income will increase from $2,402 in 1960 to $3,440 and $4,675 in 1975 and 1990 respectively.

More important by far in its implications for policy and marketing activities than the rise in total and per capita income is the dramatic realignment of income

FIG. 1

PERCENT DISTRIBUTION OF FAMILIES AND UNRELATED INDIVIDUALS BY INCOME CLASS 1960, 1975, 1990



distribution over the period.

In 1960 (see Table 1) just over one-fifth of the region's families had incomes exceeding $10,000. By 1975 this income class will account for over 50 percent of the region's families, and by 1990 nearly three-fourths will fall into this bracket. This complete inversion of the distribution pyramid suggests an explosive increase in what may be called discretionary spending power. For example, it has been assumed that the average family requires approximately $7,000 a year to maintain a modest, but comfortable level of consumption. (3) Any income in excess of this amount is assumed to be available for optional purchases. Even after recognizing the difficulty of clearly differentiating between necessary and optional or discretionary expenditures, it is clear that consumers will have a far greater freedom of choice in their spending patterns.

Specific Income Classes Families (0-$4,999)

Nothing documents the dramatic shift expected in the structure of the region's income distribution more than the absolute and relative decline in the 0-$4,999 income category. In 1960, over 28 percent of the region's families fall into this group; this proportion will decline to less than 13 percent by 1975, and to approximately 7 percent by 1990. In terms of the absolute number of families there will be a decline of 68.1 percent in this class during the 30-year period while the total number of families in the region will increase by 25.5 percent.

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(3) Based on a study of family budgets by the Bureau of Labor Statistics and reported in "Spending Power in the Seventies", The Conference Board Record, National Industrial Conference Board, Vol. III No. 3, March, 1966.

TABLE 1

Estimated Distribution of Families and Unrelated Individuals in the Planning Area, by Income Class, 1960, 1975, 1990

Income Class	Percent	Number	Percent	Number	Percent	Number
0 - 4,999	28.3	236,379	12.7	111,490	7.2	75,450
5,000 - 9,999	50.4	421,073	34.4	301,980	18.4	192,820
10,000 - 14,999	14.2	118,315	30.1	264,230	26.0	272,450
15,000 +	7.1	59,283	22.8	200,150	48.4	507,180
Total	100.0	835,050	100.0	877,850	100.0	1,047,900

Median Income: $7,151. $10,480. $14,690.

Primary Unrelated Individuals

Income Class	Percent	Number	Percent	Number	Percent	Number
0 - 4,999	81.9	140,882	62.6	117,970	46.9	98,560
5,000 - 9,999	14.7	25,459	28.0	52,770	30.9	64,940
10,000 - 14,999	2.0	3,440	5.5	10,360	14.5	30,470
15,000 +	1.3	2,236	3.9	7,350	7.7	16,180
Total	100.0	172,017	100.0	188,450	100.0	210,150

Median Income: $3,051. $ 3,995. $ 5,500.

Families and Unrelated Individuals

Income Class	Percent	Number	Percent	Number	Percent	Number
0 - 4,999	37.5	377,261	21.5	229,460	13.8	174,010
5,000 - 9,999	44.3	446,532	33.3	354,750	20.5	257,760
10,000 - 14,999	12.1	121,755	25.8	274,590	24.1	302,920
15,000 +	6.1	61,519	19.4	207,500	41.6	523,360
Total	100.0	1,007,067	100.0	1,066,300	100.0	1,258,050

Median Income: $6,414. $ 9,280. $13,260.

This 0-$4,999 income class is largely composed of persons under 25 or of persons 65 and over. Nationally, it is expected that the proportion of persons 65 and over making less than $5,000 will decline; while at the same time, the proportion of those making less than $5,000 who are 65 and over will increase. These projections are consistent with the national trends. In 1960, approximately 26 percent of those families earning less than $5,000 were 65 and over. By 1990, this proportion will rise to approximately 90 percent, if we assume that the 1960 proportion of those earning less than $5,000 (47 percent) remains constant. This, as indicated, is highly unlikely because of higher future earning power in prime working years, higher private and public retirement benefits, greater participation in equity investment programs, and a probable relaxation of present restrictions (both explicit and implicit) on part-time employment after retirement.

The other end of the age scale (25 and under) will decline as a proportion of those making less than $5,000. The primary reason for this is a combination of continuing higher educational attainment before achieving family status, and a generally rising wage structure for all occupations which will increase starting salaries above this minimum level.

Family Income ($5,000 - $9,999)

This income class is similarly becoming smaller, both absolutely and as a share of the region's total families. The rate of decline is expected to increase in the years ahead such that between 1975-1990 the number of families will decrease by 36 percent compared to 28 percent in the 1960-1975 period.

A look at the combined results in these two income classes suggests a dramatic

shift in the distribution of purchasing power held by the region's families. In 1960, nearly 79 percent of the families (657,452) were earning less than $10,000 annually; by 1990 this proportion will have declined to less than 26 percent.

Family Income ($10,000 - $14,999)

This income class will increase in absolute size between 1960-1975 and again between 1975 and 1990. The rate of increase, however, will be such that this group's share of the region's families will increase from 14.2 percent to 30.1 percent between 1960 and 1975, declining thereafter to 26.0 percent by 1990.

In a sense, given these particular income classes, this earning level will be a pivotal point in the years ahead. Many families will be moving up from the lower income groups, while, at the same time, other families will be pushing on into the higher income brackets. As a result, the net change in this category is not perhaps as dramatic as in some of the other categories. Nevertheless, there will be over twice as many families in this income group in 1990 as were recorded in 1960. This is a significant fact, for at this level of income the region's families have a substantial proportion of their spending power available for discretionary items.

Both regionally and nationally, this income class is expected to grow younger. In part, this anticipated shift in age mix reflects the broad trend in population generally, but more importantly the fact that a larger proportion of older persons, as compared to younger ones, are already in the upper income brackets.

Family Income ($15,000 and Over)

In 1960, less than 60,000 families (7.1 percent) had earnings which placed them in this high income bracket. By 1975, this group will have increased to over 200,000

families (22.8 percent); and by 1990, nearly one-half of the region's families will fall into this category. The most significant aspect of this development from a marketing standpoint is the fact that an estimated two-thirds of the total buying power of this bracket is discretionary.

This group is also expected to grow younger, although this shift will not be as pronounced as in the next lower category. In the main, however, a larger proportion of the region's spending power will be in younger hands in the years to come.

Primary Unrelated Individuals

The shift in the distribution of the region's primary individuals(4) among income classes is considerably different than that of the region's families. In addition to the shift in distribution, two other facts are worth noting. First, unrelated individuals accounted for only 17 percent of the region's total households in 1960, and this share will remain virtually unchanged during the projection period.

Secondly, the average age of the primary individuals is significantly greater than that of the family groups. For example, it is projected that 19.7 percent and 18.6 percent of the region's families will be over 65 in 1975 and 1990 respectively. Among the primary individuals, however, the comparable percentages are 40.0 and 60.7 in 1975 and 1990 respectively. As a result, the projected median ages show a similar divergence. Thus, for families the projected medians are 49.2 and 44.5 in 1975 and 1990 compared to 60.9 and 60.7 for unrelated individuals.

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(4) See page 3 for definitions.

Primary Individual Income (0 - $4,999)

As in the family distribution this income class is expected to include a declining share of the region's primary individuals. In 1960, over 80 percent of the primary individual households were earning less than $5,000; by 1990, this proportion will be down to approximately 47 percent. Unlike the case with families, however, these individual households will not experience any inversion of the distribution over the projection period. Thus, the lowest income class will continue to be the single most important category despite its declining relative share.

Primary Individual Income ($5,000 - $9,999)

The number of primary individuals falling into this category will increase from 25,459 in 1960 to nearly 65,000 by 1990 increasing its proportion of the region's total from 15 percent to 31 percent.

The increase in the relative importance of this income class is in sharp contrast to the expected shift in the family distribution where this class will decline significantly.

Primary Individual Income ($10,000 - $14,999)

This income class will experience the most significant increase in relative and absolute importance over the projection period. While only 2 percent of the region's unrelated households had earnings above $10,000 in 1960, this income bracket will include nearly 15 percent of the total by 1990.

Primary Individual Income ($15,000 and Over)

The number of primary households earning $15,000 or over is projected to increase by nearly 14,000 between 1960 and 1990. This nearly eight-fold increase will

shift this category's relative share from 1.3 percent in 1960 to 7.7 percent in 1990.

Median Incomes

Table 1 also indicates the median incomes computed from the estimated distributions.(5) For the region's families, the median income will reach $14,690 by 1990, more than double the 1960 level. The computed median for unrelated individuals is considerably less than that for families, as is the rate of change over the projection period.

It should be noted that these medians are computed from the estimated and projected distributions. Since there are no published census statistics for the specific geographic area under study, these estimates will differ from those in the Census of Population or other publications.

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(5) The median represents the mid-point of the distribution. Thus, it can be stated that one-half the families have incomes above this amount, and one-half have incomes below this amount.

IMPLICATIONS OF THE PROJECTIONS

The impact that the projected rise in purchasing power will have in allowing consumers to allocate a larger portion of their budgets for discretionary items has already been noted. It can be assumed that the region's consumers will demand not only higher quality, and thus more expensive, necessities but also a wider range of luxury items.

The shifting pattern and amount of spending on specific items over the projection period cannot be estimated with any large degree of confidence. Consumers will have many alternative ways of spending this discretionary income. It may take the form of two automobiles instead of one, the purchase of a summer cottage, out-door camping equipment, a boat, more extensive and expensive vacation travel, more theatres and concerts, greater use of restaurant facilities, prepackaged foods, household convenience goods or any one of several other "luxury items". Without being specific about individual items it is certain that a larger proportion of total expenditures will be directed toward recreation, personal services, health, education, and travel while a smaller proportion will go toward the basic necessities of food, cloth-

ing, and shelter. These projected trends are discussed in more detail in the Economic Base and Population Study.

Beyond the fact that rising real incomes and therefore increased discretionary spending power present a real challenge and opportunity for a wide variety of markets, there is also the fact that they create very real problems in terms of land use, community facilities, and social planning. It is this type of problem that is of more immediate concern.

* As the number of households earning less than $5,000 declines, the absolute demand for low and moderate cost housing, as now understood, will also decline. Because "poverty" families will become even less visible, due to significant increases in general well-being, it may become more difficult to generate public support for poverty programs including low-income housing that may be required.

* It would appear that most of the demand for low-cost housing will come from elderly families and single individuals. Despite the decline in absolute demand, finding suitable alternative quarters for elderly, low-income households may becom exceedingly difficult since in 1960 about 20 percent of all persons over 60 years of age in the Boston SMSA lived in areas identified as requiring gradual reconstruction.

* Expansion of public programs to upgrade existing residential "gray" areas may very well have to occur at an unprecedented scale in the face of rapid upward shifts in income distribution. The increase in discretionary income, especially for those households who had been toward the lower end of the income scale, will likely promote increasing dissatisfaction with their present accommodations, neighborhood environment, and level of public services. Increased incomes will provide these people the alternative of either moving into new quarters or rehabilitating. Therefore, the decision may largely be based upon the level of public services including police protection, educational facilities, and non-regional recreation facilities such as swimming pools, skating rinks, bicycle paths, etc. It seems clear that the rapid shift in income distribution which occurred from the middle 1940's to the present was a major factor in the flight of the population out of the core areas.

* To the extent that increasing income levels generate significant demand for new construction the filtering process may increase the supply of physically adequate housing for those remaining at the lower end of the income scale. As previously implied, the adequacy of older existing housing at the price that can be afforded by lower-income groups has not been determined.

In general, the dramatic rise anticipated poses very real planning problems in terms of the whole structure of the housing market in the region and in the individual cities and towns comprising the region. It is imperative that redevelopment authorities, planning agencies, and city officials give serious thought to the future role of the cities, the means by which these areas can become attractive residential areas for an overwhelming number of families who will possess the means of selecting alternative locations, and whether or not present policies may not need rethinking and restructuring if this goal is to be achieved.

* It is clear that increasing attention has to be given to recreational land-use planning. The increase in discretionary income almost guarantees increasing demand for recreational facilities. Among other things, this suggests the need for expanded marinas, campsites, hunting-fishing preserves, private aircraft storage facilities, etc.

Finally, despite rapid rises in real income, the region will not be able to finance all its public requirements at once. Priorities must be established to achieve agreed-upon goals.

METHODOLOGY

A graphical method of projection was used that is put forth by David Durand in "A Simple Method for Estimating the Size Distribution of a Given Aggregate Income", Review of Economic Statistics, November 1943. The major assumption underlying this method is that the Lorenz curve will remain unchanged. A Lorenz curve is a graphic device indicating the distribution of income among the spending units of a specific geographic area. An absolutely equal distribution of income would be represented by a straight line inclined at an angle of 45 degrees. In this case, one-tenth of the total spending units (families) would receive one-tenth of the total family income, etc. The greater the departure from equality, the more widely will the curve of cumulative relative frequencies depart from the line of equal distribution. The graphs appearing at the end of this paper are not true Lorenz curves in that they indicate the cumulative percentage of families earning less than a specified absolute level of income, rather than showing the share of total income earned by a cumulative percentage of families.

The projections assume that each income group will share equally in the increase

in mean income. Thus, an increase by $1 + \frac{1}{a}$ in mean income will result in a decline of $\frac{a}{a+1}$ in the proportion of population making less than X dollars under the old distribution. The cumulative income distribution for the population in a base year, and the rate of increase in mean income for the period are needed to make the projections.

The income distributions used as a base for the projections were taken from the U. S. Census of Population: 1960 as reported for "Families" and "Primary Individuals" in the Boston SMSA.(6) The unrelated individuals in the $10,000 and over class as reported for the Boston SMSA (Table 135) were distributed into $10,000 - $14,999 and $15,000 and over classes on the basis of the proportion of the over $10,000 class in the $10,000 - $14,999 and $15,000 and over groups for the State (Table 65).

The projected increase in mean income was derived from the Metropolitan Area Planning Council's Economic Base and Population Study for the region. In order to achieve comparability between Census data and Economic Base mean cash income estimates, the latter were adjusted downward to the Census mean by the ratio of the 1960 Census mean to the total regional cash income mean.

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(6) U. S. Bureau of the Census, U. S. Census of Population: 1960 Vol. I, Characteristics of the Population, Part 23, Massachusetts. Tables 76 and 135.

The calculated percentage increase in mean income for the region is as follows:

1960-1970	34.13
1970-1975	15.60
1975-1980	14.01
1980-1985	10.61
1985-1990	10.49

The projected percentage increase in adjusted mean income for the region was then applied by the Durand technique to the 1960 distribution of families and unrelated individuals for each five-year period to obtain income distributions for the Planning Area in 1975 and 1990.

Other Approaches

Several other attempts were made at fitting historical income distributions to frequency functions of the distributions prior to the decision to use the graphic method described above.

Income distributions were constructed for nine postwar years, the frequency distributions computed, and the points fitted to a quadratic frequency function. The frequency function of the income distributions were all bell shaped with a maximum value very close to the mean income for the population. The distribution curve was described by considering the percentage of the population in an income class at the midpoint of the class. The percentage of population in an income class was then considered to be a function of the distance of the midpoint of the income class from the mean.

The specific form of the function was a log-log quadratic. First the percentage of population in each income class were transformed into logs, then the distance of the midpoints of the income classes from the mean income for the population were

transformed into logs. Then the log of the distance of the midpoint of the income class from the mean was squared. Thus, the form of the function to be fitted was $\log P = a + b(\log D) + c(\log D)^2$.

The income distribution has some inherent properties which need to be considered. The income distribution is restricted to values greater than zero and the sum of all the percentages of the classes must equal one hundred percent. Thus, the higher the mean income the lower will be the maximum percentage in the class containing the mean. We would expect a general flattening of the frequency function as the mean income increases, and this expectation is verified by the historical data.

In an attempt to flatten the curve an additional term was added to the frequency function to correct for the shift in the mean. This term is the log of the mean income. Thus the full frequency function fitted to the historical data was:

$$\text{Log } P = a + b(\log D) + c(\log D)^2 + d(\log y)$$

The above function fitted the data very well; the table of analysis of variance is shown below with the coefficients.

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square
X_2, X_3, & X_4	80.19454	3	26.73151
residual	12.73562	113	.11270
Total	92.93016	116	

$R_2 = .86295$ $F = 237.192$ $F(3/113)_{.99} = 3.98$

$P_i^* = 1.21080_i - .09847D_i^* - .17220D_i^{*2} + .93064Y_i^*$
where the * indicates a log value.

The tests of "goodness of fit" were encouraging but the sign on the last term would be expected to be negative, not position. But in the quadratic, as opposed to

the log quadratic, both coefficients are negative and the roots of the quadratic are imaginary.

For all this encouragement, both of the projected income distributions had some unacceptable characteristics. First, the cumulative frequency for all classes is considerably greater than 100 percent, and the percentage in the mean class shows the unexpected tendency to rise. These two characteristics led us to believe that the projections of the income distribution on the basis of the historical frequency function were unacceptable, and thus are not presented.

One more attempt was made to statistically fit a frequency function to the historical cumulative income distribution by using a log-reciprocal transformation. The fit of this function to the data was poor, $R^2 = .45464$, with .95 significance for $n = 9$, $R^2 = .6021$, $F = 5.83589$, with $F\ (1/7)_{.99} = 5.59$ and $F\ (1/7)_{.99} = 12.25$.

Fits of this significance were considered unworthy of further efforts at projections over a 30-year period with a projected 93 percent rise in average family income. Neither of the above methods of fitting and projecting the income distribution statistically gave satisfactory results.

FIG. 2

CUMULATIVE INCOME DISTRIBUTION: FAMILIES PLANNING AREA 1960-1990

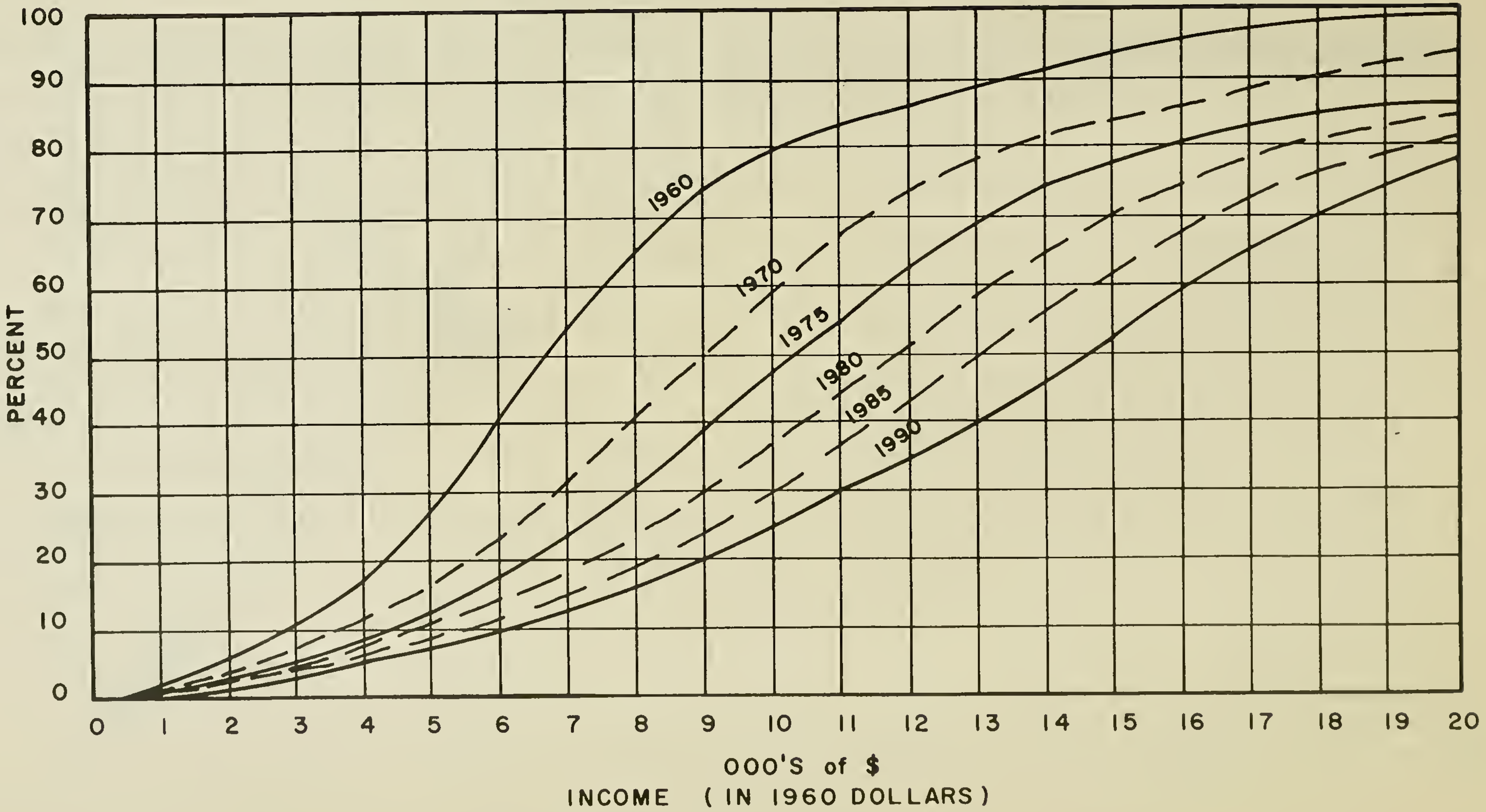
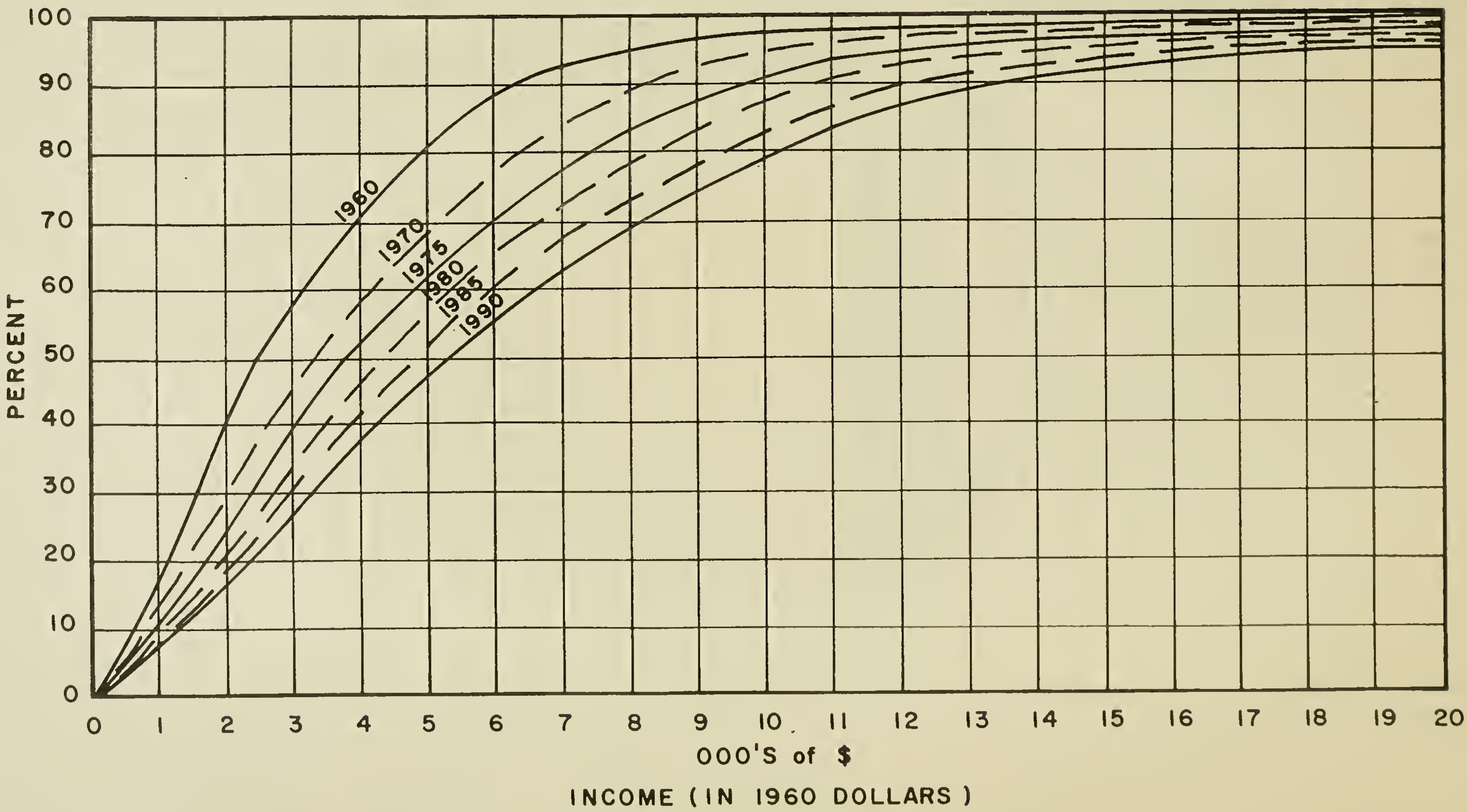


FIG. 3

CUMULATIVE INCOME DISTRIBUTION: UNRELATED INDIVIDUALS PLANNING AREA 1960-1990



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Projected distribution of
families and unrelated indi-
viduals by income class.